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Production of Formed Coke by Auto-Hardening CFRI's Process

The meagre resources of coking coal have been causing concern to the planners of the country for quite some time past. The life of the prime coking coal reserves is being prolonged by incorporating non-coking coal in the 'coking blends' while adopting improved techniques to counteract deterioration in coke properties. The production of formed coke entirely from non-coking coals has been engaging the attention all over the world.

The Central Fuel Research Institute (CFRI), Dhanbad developed a few years ago a process for the production of metallurgical or domestic formed coke from non-coking coals. The mechanism and kinetics of the oxidative hardening reaction responsible for the development of adequate physical strength in char-tar briquettes (formed coke) was also studied. It was found that hardening was chiefly due to the oxy-polymerization reaction between the tar (binder) and oxygen.

In a more recent study, the hardening of the briquettes has been achieved by heating them in a non-oxidizing atmosphere at 200-350°C with the incorporation of suitable additives in stoichiometric proportions, which release oxygen *in situ* during heating. Thus, the same oxy-polymerization of tar and consequent hardening of briquettes is attained as was earlier achieved by treatment in an oxidizing atmosphere. The additives investigated so far are MnO_2, CuO, Fe_2O_3, V_2O_5, nitrates of a number of metals, ammonium nitrate, and sulphur.

With about 25% MnO_2 in the composition of char-tar briquettes, optimum strength could be developed by simple heating at 350°C in inert atmosphere. The point of maximum development of strength has been found to correspond to the release and consumption of 4·5 g of oxygen from MnO_2 per 100 g of dry briquettes containing 12 g of tar as binder—precisely the same as was earlier established in air-hardening treatment. In contrast to oxy-hardening of char-tar briquettes, MnO_2-incorporated briquettes could be adequately hardened within a very short period by heating straightway at 500-1100°C without any damage to the briquettes. In other words, hardening and carbonization could be combined into a single step. This was experimentally confirmed by a follow-up test in the CFRI pilot plant coke oven.

The results of tests with CuO, Fe_2O_3 and V_2O_5 indicated that CuO was a better oxidant than the other two. Inordinately high proportions of Fe_2O_3 and V_2O_5 were found to be required for completion of the reaction—an obvious disadvantage in auto-hardening treatment.

Among the nitrates, calcium or ferric nitrate has been found to be a suitable hardening agent causing the same oxy-polymerization of tar (binder) as can be done by the oxides.

Sulphur has also been found to be an efficient agent for thermal hardening of formed coke but the residual sulphur in the coke may militate against its use for metallurgical purposes. The use of a lower proportion of sulphur during auto-hardening followed by carbonization may yield formed coke suitable for metallurgical use.

Compared to ordinary formed coke produced by the usual oxy-hardening treatment, the extra cost due to the incorporation of auto-hardening agents may, in some cases, be more than offset by the advantages, viz. (i) higher throughput, (ii) simpler equipment and easier control of the process, and (iii) premium for the metallic content of the formed coke (already partially or fully reduced during the hardening step) in subsequent metallurgical operations.

Different types of additives used make different kinds of formed coke each with its own merits for specialized uses in metallurgy. Formed coke produced by auto-hardening with MnO_2 may be found attractive for the manufacture of high-manganese pig iron, spiegel or spiegeleisen as well as ferro-manganese. For blast furnace use, where high manganese content is undesirable, lesser proportion of MnO_2 additive (4-5%) may be used and such briquettes may be adequately hardened by treating in air straightway in a single stage at as high a temperature as 280°C.

In non-ferrous metallurgy, as for instance copper metallurgy, formed coke of adequate physical strength produced by CuO additive may not only function as a good smelting and reducing agent but is likely to augment the production of metallic copper.

Formed coke produced by calcium nitrate additive would be a self-fluxing (partially or wholly, depending on the ash content of the char used) coke and thus may have an added advantage over the conventional coke in blast furnace practice.

The success of the auto-hardening process of production of special formed coke containing metalliferrous additives would ultimately depend on the actual finding of some special uses for it in metallurgical operations, both ferrous and non-ferrous. Such trials are required to be carried out and if found successful, this technique may open up a new avenue and an unlimited scope for the utilization of the abundant resources of non-caking coals for metallurgical purposes.

Technologists for Food Industry
CFTRI's Training Course

A major problem with which several developing countries in Asia are increasingly concerned is the raising of food production to meet the demand of rapidly growing population. The overall agricultural development programmes have no doubt helped increase food production in these countries, but huge amounts of food are lost through improper storage, transport and distribution, or for lack of trained scientific and technical personnel or adequate equipment for its processing and preservation. The food resources can be utilized to the maximum extent with the help of modern scientific methods of storage, preservation, processing and distribution, as is done in several of the more advanced countries in the west. A prerequisite for this is necessarily the training of food technologists to carry out comprehensive and well-planned research and development programmes.

Training of food scientists and technologists is one of the important activities of the Central Food Technological Research Institute (CFTRI), Mysore. To start with, a Diploma course extending over a period of one year in fruit technology was conducted from as early as 1950. This training course was later scaled up to a two-year Associateship course with emphasis on fruit and vegetable technology in particular and food technology in general. In addition to theoretical and practical work, extra curricular classes were arranged in several related fields of food technology such as biochemistry, nutrition, food engineering, infestation control, and meat and fish technology. This course having proved highly useful, it was felt desirable to institute a regular post-graduate course in food technology leading to a university degree.

In 1964, the scope of the training was enlarged as a result of an agreement between the Government of India and FAO, and the FAO International Food Technology Training Centre came into being at CFTRI. The location of the International Training Centre at CFTRI was decided upon as the institute provided all modern facilities and well-trained staff for the purpose. The Centre has been imparting instruction and training in various aspects of food preservation and utilization to students and trainees from India and from several South and South-East Asian countries for the past five years.

The Canadian Hunger Foundation through 'Canada-Mysore Project' made generous financial contributions for the expenses of the participants and also for some equipment requiring foreign exchange. The support from the Government of India for running the Centre has also been considerble.

The main function of the Centre is to prepare graduates of high academic merit from India and from countries of South and South-East Asia for the Master of Science degree in food technology of the University of Mysore.

Five post-graduate courses, each of two years' duration, have been completed. In all, 104 students completed the post-graduate courses; of these, 40 were from overseas.

The two-year post-graduate course consists of four semesters of approximately six months' duration. University examinations are held at the end of each semester. The syllabus and the system of examinations are reviewed from time to time and suitable changes are made to keep abreast of the fast changing technology in the field.

As a supplement to the class room lectures, the students are taken on field trips to various food factories in India. At the end of such tours, the students submit tour reports of their observations and these are discussed. In-plant training at the end of the course is a special feature. Several food industries in the country have extended their cooperation in affording in-plant training (6-8 weeks) facilities to the students.

The students admitted to the course are financially supported by FAO, the Indian food industries and the Government of India through the Colombo Plan.

The Centre also organizes short refresher courses periodically to provide practical training in specific fields of food technology for professional people, mainly sponsored by food processing industries and government organizations. These courses cover fruit and vegetable technology; infestation control in raw and processed foods; meat, fish and poultry technology; analysis, standardization and quality control in food processing industries; and flour milling and baking technology. Till now, eight short-term courses have been held at the Centre and 173 persons trained. Of these, 92 were from South-East Asian countries and Ceylon.

The countries which send students for post-graduate and short-term courses include Burma, Cambodia, Ceylon, Indonesia, Japan, South Korea, Laos, Malaysia, Nepal, Pakistan, Philippines and South Viet Nam and Thailand. The largest number of overseas students for both short-term and post-graduate courses so far has been from Thailand which has sent 31 students, followed by South Korea (25), Philippines (23), Ceylon (22) and Nepal (14).

Every effort is made to ensure that the participants derive maximum benefit from all the academic, social and cultural amenities available at CFTRI. Recently, an international hostel has been constructed in the campus with Canadian aid.

Dr H. A. B. Parpia, Director, CFTRI, is also the Director of the International Food Technology Training Centre. Dr S. P. Manjrekar is the Chief Coordinator for the programme. About 40 scientists from the institute, who are specialists in various fields of food technology and allied subjects, participate in the training programme. Specialists from institutions abroad are also invited to participate in the programme as visiting lecturers.

Integrated Circuits : CEERI's Work

B. R. Marathe
Central Electronics Engineering Research Institute, Pilani

PROGRESS IN electronics has been spectacular in recent years. Vacuum tube, discovered only about half a century ago, has introduced a new method in communication of information. In the late forties, the transistor was discovered and it took only a decade for this new device to mature and surpass its predecessor—the vacuum tube. In the early sixties, the application of a new concept produced yet another device—the integrated circuit. This device provides a complete circuit with active and passive components including interconnections on a chip not much larger than the one required for a transistor and with a price several times less than that required for a circuit, using discrete components. With the advantages of higher reliability, lower cost, smaller size and weight and smaller power requirements, the integrated circuit has revolutionized the electronics industry.

There are basically three technologies which are utilized in the fabrication of integrated circuits, the semiconductor technology, the thin film technology and the thick film technology. Monolithic circuits utilize the semiconductor technology for the fabrication of both active and passive components and the thin film technology for interconnections. All these components are fabricated on a silicon chip. The hybrid circuits utilize the thin or thick film technology for fabricating the passive components and the semiconductor technology for active components. These components are fabricated or attached on to an insulating substrate like glass or ceramic and interconnected either by metallized patterns or by thin metal wires.

The monolithic circuits again can be formed using either the bipolar or the MOS devices or both. Digital and linear circuits can be fabricated utilizing the monolithic or hybrid approach. The earlier developments in the integrated circuits were in the digital field for applications in computers, defence and space electronics. Linear integrated circuits closely followed the digital ones and are now being used in the consumer electronic equipment. With better understanding of the materials and processes, integrated circuits with novel features are now available in most of the advanced countries. These circuits are now finding numerous applications in a variety of electronic equipment.

What is the future of integrated circuits? Would these also be surpassed by yet another novel device? It is difficult to predict. A legitimate guess for the coming two decades would be that the complexity of these circuits would increase and their size would shrink. There would be further improvement in materials and processes utilized in the fabrication of these circuits. Automation would increase in the manufacture of integrated circuits and higher yields would be achieved. To some extent this trend is evident from the work on large scale integration where a number of circuits, all interconnected, are fabricated on a wafer of silicon. Fabrication of functional devices where the components have no identity with any particular part of the device but where the device functions as a whole, might form yet another approach in future in the field of integrated circuits.

The Central Electronics Engineering Research Institute (CEERI), Pilani has been presently working on the fabrication of monolithic digital integrated circuits with bipolar devices.

Process

Starting Material

The starting material for integrated circuits is an epitaxial silicon wafer about 3 cm in diam. and 0·03 cm in thickness. This consists of a single crystal n-type (resistivity about 0·5 ohm cm) epitaxial silicon layer, 10^{-3} cm in thickness, over a p-type (resistivity, about 10 ohm cm) silicon substrate. All the active and passive devices are fabricated in this epitaxial layer. These devices are isolated from each other by reverse biased p-n junctions obtained by p-type isolation diffusion which reaches the p-type substrate. Fig. 1 indicates the areas (black portions) into which the isolation diffusion takes place.

Photolithography

Since diffusion has to be carried out in small selected areas, photolithographic techniques are used. The wafer is first oxidized and coated with a photoresist, then it is exposed to ultraviolet light through a mask having transparent and opaque areas. The ultraviolet light hardens the areas exposed to it and the rest of the photoresist is removed after developing. If the wafer is now placed in an oxide etching solution, all the oxide except that protected by the hard photoresist is removed. The hard photoresist is next removed and a wafer which has windows (openings) in the oxide is obtained.

Diffusion

Impurities can now be diffused into the portions of the wafer which have no oxide. On other areas of the wafer, the oxide inhibits the diffusion of impurities into the silicon below it. Diffusion is normally carried out in furnaces at temperatures in the range 1000°-1200°C. Fig. 2 is a photograph of the furnaces used for diffusion and oxidation. At room temperature, the diffusion of impurities is negligibly small. The temperature of the wafer and impurity and the time of diffusion control the amount of impurity diffused as also the depth of diffusion.

Active and Passive Components

A diode is formed by diffusing one type of impurity into silicon containing another type of impurity. Impurities in silicon which make available excess electrons are called n-type impurities and the silicon is called n-type. Those impurities which provide excess holes are called p-type impurities. A p-n junction thus acts as a diode. A sandwich of two junctions having a p-n-p or n-p-n structure acts like a transistor.

A p-n junction has a junction capacitance which is voltage dependent. A layer of diffused material can act as a resistor. By choosing the length and width of this layer and the impurity content, the resistor value can be varied.

Fig. 3 shows the areas (black portions) where the next p-type diffusion (called base diffusion, since

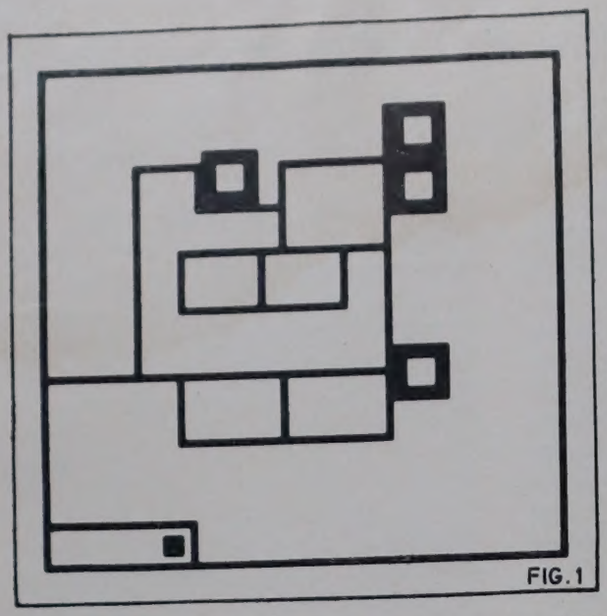

FIG. 1

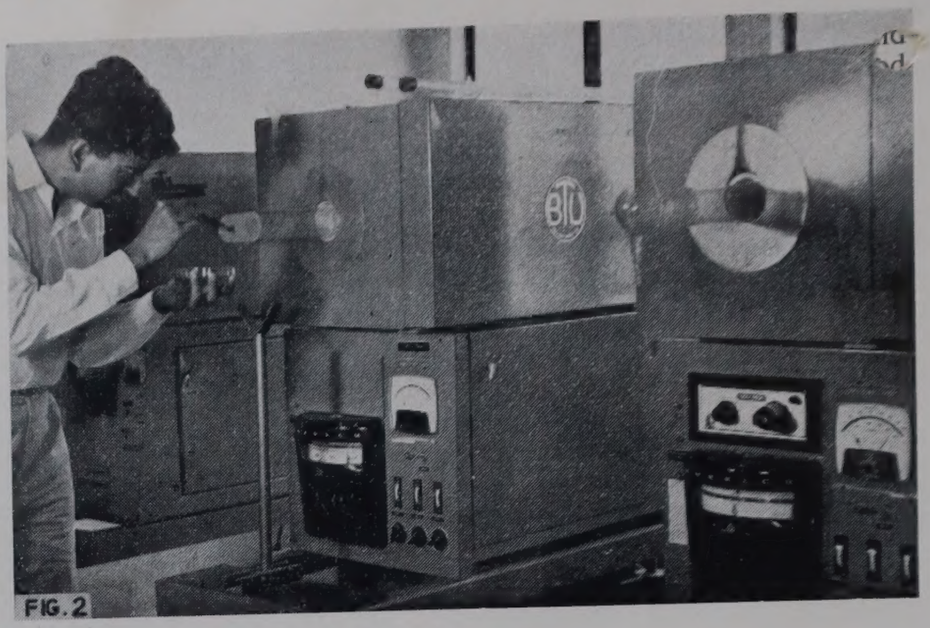

FIG. 2

FIG. 6

Fig. 1—Area for isolation diffusion

Fig. 2—Furnaces for diffusion and oxidation

Fig. 3—Areas for base diffusion and resistors

Fig. 4—Areas for emitter diffusion

Fig. 5—Contact windows, diodes, transistors and resistors

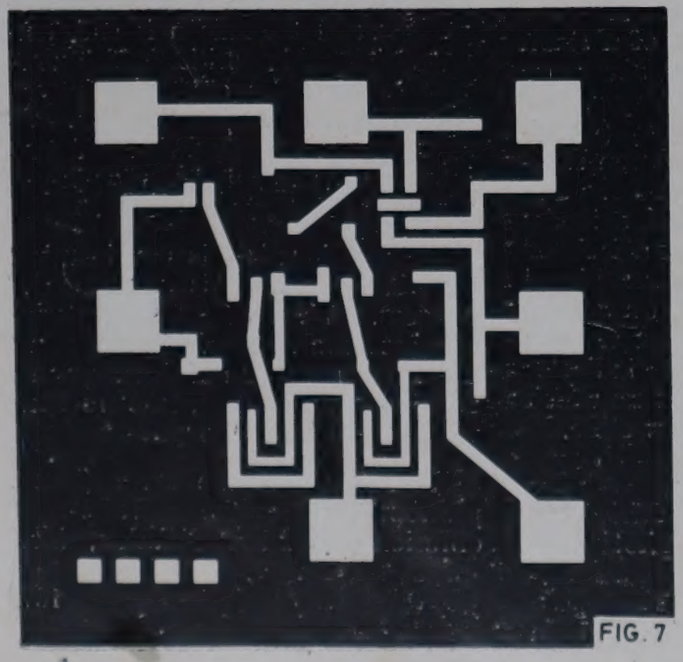

FIG. 7

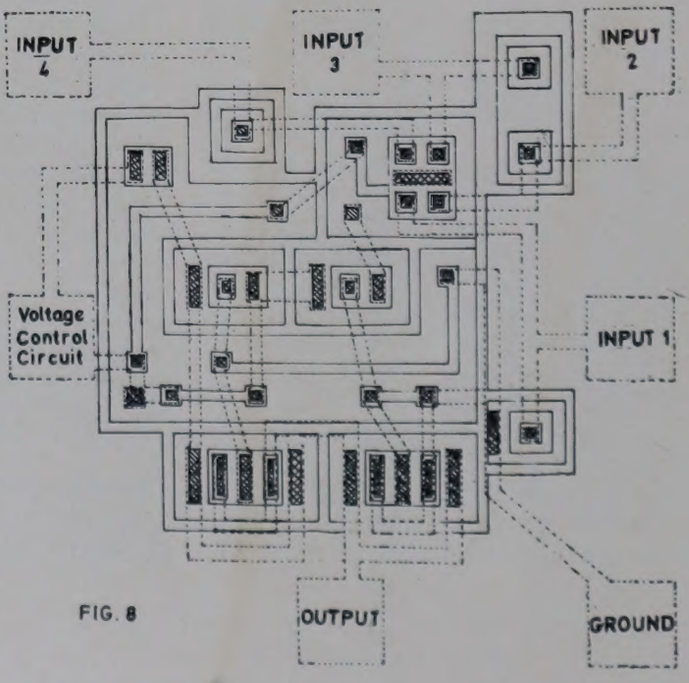

FIG. 8

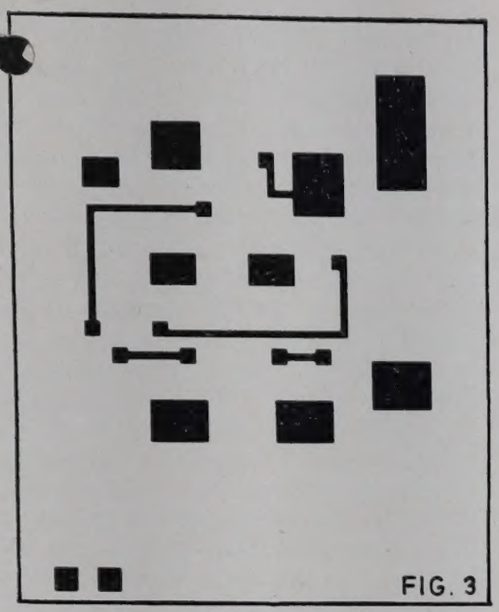

FIG. 3

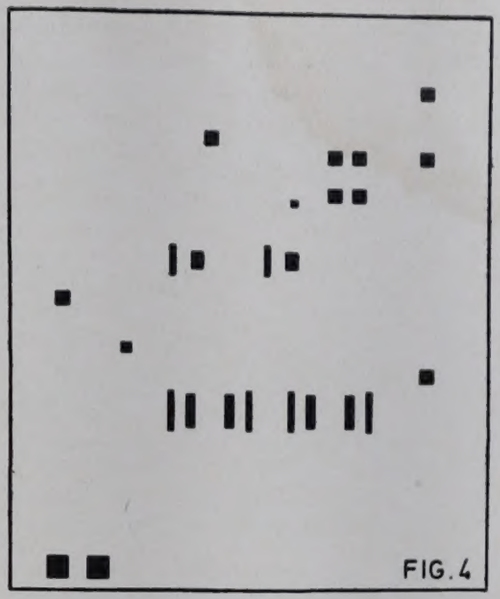

FIG. 4

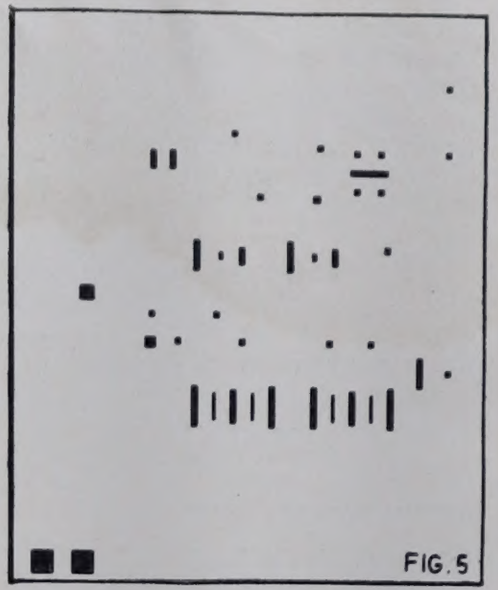

FIG. 5

Fig. 6—Vacuum coating unit

Fig. 7—Interconnection pattern

Fig. 8—Photograph of a chip (TTL NAND gate)

Fig. 9—Ultrasonic wire bonding machine

Fig. 10—Integrated circuit testing equipment

Fig. 11—Step and repeat camera for preparing photographic masks

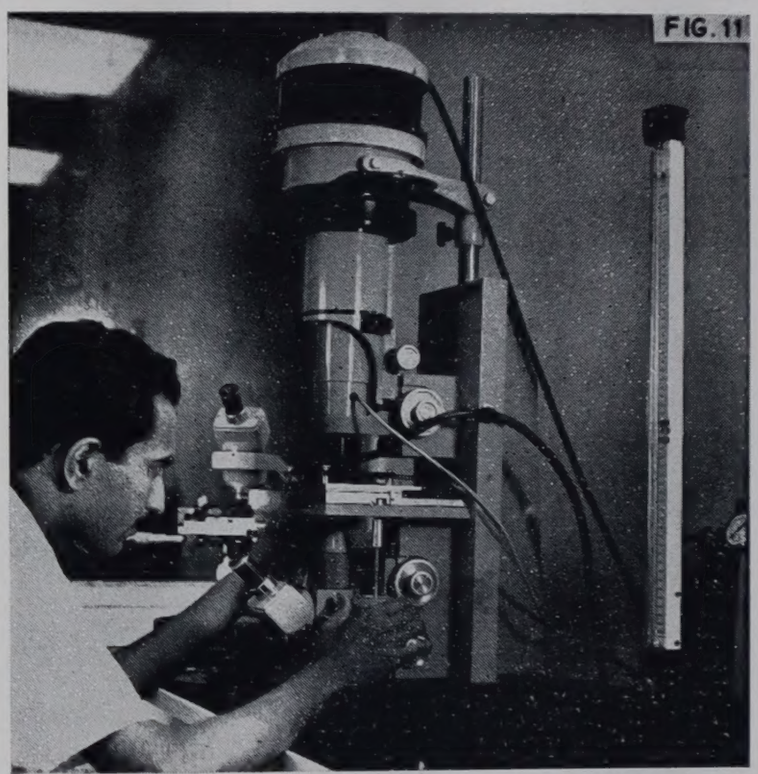

FIG. 11

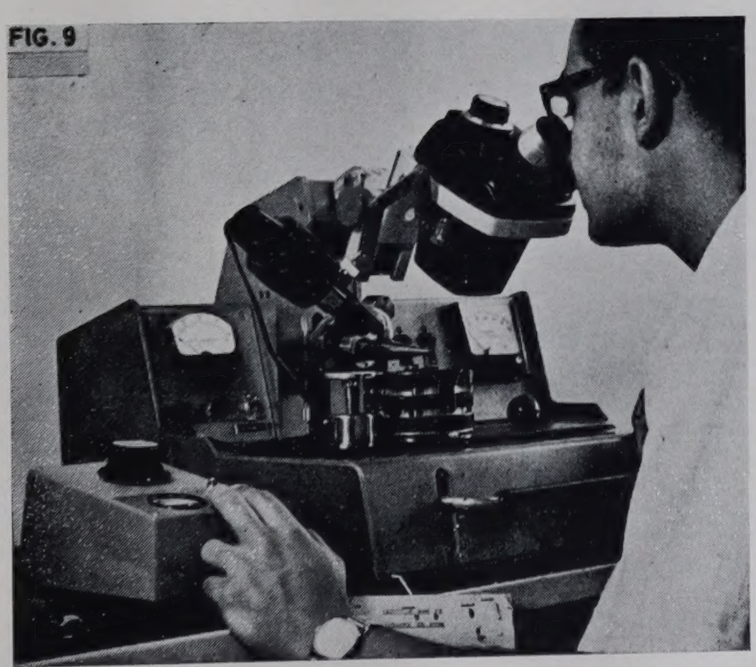

FIG. 9

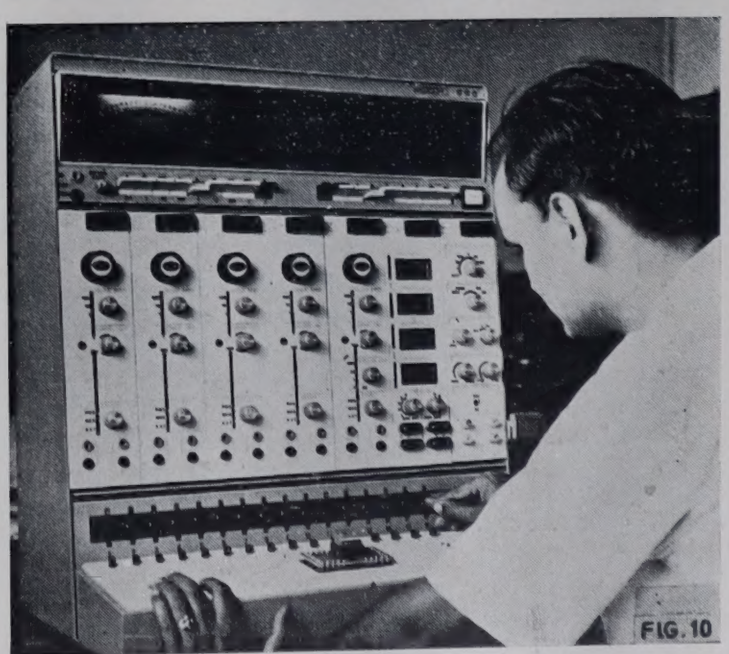

FIG. 10

this diffusion forms the base of the transistors) is carried out. Apart from forming the base of the transistors, this diffusion forms diodes (some of which could be used as capacitors) and resistors (corresponding to the thin black portions in the figure).

Fig. 4 shows the areas where the next n-type diffusion (called emitter diffusion) is carried out. This forms the emitters of the transistors and it brings out contacts from the collector to the top of the wafer. To obtain contact areas to the different devices, windows are opened in the oxide as shown in Fig. 5.

Interconnection of Devices

A layer of metal, usually of aluminium, is now vacuum evaporated on the entire wafer (Fig. 6). Retaining the interconnection pattern (Fig. 7), the rest of the aluminium is etched away, again using the photolithographic technique. The aluminium is next sintered to the wafer surface at an appropriate temperature.

Probing and Testing

Using a probing machine and testing equipment, the integrated circuits can now be tested and the faulty ones marked with ink. At various stages of the fabrication, tests are also carried out, thus evaluating the fabrication process.

Scribing, Encapsulation and Final Testing

The wafer is now scribed into individual chips, each containing a circuit. Fig. 8 is a photograph of such a chip. The chip is next bonded to a multi-pin TO-5 header and thin (about 25×10^{-4} cm) gold wires are bonded to the circuit terminals and pins of the header (Fig. 9). A cap is next welded to the header in an inert atmosphere. The complete circuit is finally tested for its performance (Fig. 10). Apart from the multi-pin TO-5 packages, other packages like dual-in-line or flat packges can also be used.

Preparation of Photographic Masks

The photographic masks required in the photolithographic process in the fabrication of integrated circuits are made using a first step reduction of the drawing and then repeating the pattern with the help of a step and repeat camera (Fig. 11).

As the size of an integrated circuit is small, cleanliness is an important factor in the fabrication areas. Even a few tiny dust particles could result in poor yield of the devices. Many of the fabrication steps are carried out with the help of microscopes.

The oxide acts as a mask for diffusion, and hence a number of oxidation steps are necessary in the fabrication of an integrated circuit. Thermal growth of oxide is normally used.

Since there are a number of chemical cleaning and etching steps in the process, high purity chemicals are required to avoid introduction of impurities.

Present Status of Work at CEERI

After creating most of the facilities for fabricating integrated circuits, the institute fabricated a number of discrete components on a wafer to gain experience on the fabrication process. Fabrication of a DCTL NOR gate was next taken up. A few integrated circuits of this type have been fabricated and tested. This work has established the feasibility of fabricating a simple integrated circuit. However, more efforts would be needed to achieve the desired characteristics and reproducibility.

The present work relates to the fabrication of a four-input TTL NAND gate. After fabricating this circuit, work on the fabrication of a quad two-input TTL NAND gate would be taken up. This is a fairly complex circuit and has been selected because of its applications in the work at the institute and in computers.

Diffusion in Solid State

Studies on diffusion in solids have assumed increasing importance in the present state of development of high temperature technology since most of the high temperature reactions in solids, viz. precipitation, oxidation, corrosion, phase transformation, sintering, etc. are diffusion controlled. Use of radioactive isotopes and the availability of the high purity metals with a simultaneous advance in the experimental techniques have made it possible to obtain the values of intermetallic diffusion coefficients with high precision.

The results on the intermetallic diffusion have been interpreted from two different points of view, viz. (i) the electrostatic theory of Lazarus modified by LeClaire; and (ii) the elastic theory of Swalin. In the electrostatic theory, the electrostatic interaction between the solute ion and the Fermi electrons of the solvent lattice is considered important in determining the value of the activation energy for impurity diffusion. The effects of the relative sizes of the solute and the solvent atoms have been ignored. On the other hand, the elastic theory takes into account the effects of the relative sizes of the solute and the solvent atoms and their elastic properties but neglects the difference between the valencies of the solute and the solvent atoms. In order to compare the suitability of the electrostatic model and the elastic model and to explain the experimental results on the impurity diffusion in a solvent, studies on the diffusion of ^{110}Ag and ^{124}Sb in aluminium were carried out in the temperature interval 450°-630°C. The studies were made by Shri S. Badrinarayanan of the National Chemical Laboratory, Poona under the guidance of Dr H. B. Mathur of the laboratory. The activation energies for the diffusion of ^{110}Ag and ^{124}Sb in Al are close to the activation energy for the self-diffusion in aluminium, indicating that the diffusion of ^{110}Ag and ^{124}Sb in Al takes place through the vacancy mechanism. The experimental results were found to be consistent with both the electrostatic and the elastic models for intermetallic diffusion. It is not possible to say which of the two models gives a better description of the impurity diffusion unless the values of the activation energies are known with a greater accuracy than can be determined by the presently available methods of studies on intermetallic diffusion.

In rare earth ions from La^{3+} to Lu^{3+}, there is a series of metal ions which exhibit a general valency of three but have ionic radii and moduli of elasticity which change with the atomic number. These, therefore, constitute a very suitable system for obtaining more definitive information on the elastic model. The diffusion of the rare earth tracers ^{141}Ce, ^{147}Pm, $^{152+154}$Eu, ^{160}Tb, ^{170}Tm and ^{177}Lu in copper was therefore studied in the temperature interval 700-1000°C. The diffusion profiles were analysed both by the residual activity method and

sectioning method. The diffusion profile, when analysed by the sectioning technique, showed that the plot of log specific activity versus square of the penetration depth was in the form of a curve which consisted of two straight lines of distinct slopes. The diffusivities calculated from the slope of the first straight line extending the depth $<20\mu m$ were in good agreement with those obtained by the residual activity method for the same annealing temperature. At a fixed temperature, the value of D calculated from the slope of the second straight line was found to vary from specimen to specimen. Hence it was concluded that the second diffusion profile was structure-sensitive. The first straight line portion was attributed to the volume diffusion and the second straight line segment to the diffusion through the crystal imperfection such as dislocations.

The activation energies ($Q=23$-28 kcal/mole) and the frequency factors ($D_0=10^{-7}$-$10^{-9}\times cm^2/s$) are found to be very low when compared with those for the self-diffusion in copper ($Q=47.14$ kcal/mole and $D_0=0.47$ cm^2/s). The low values of D_0 and hence the values of the diffusivities D have been attributed to a low concentration of vacancies in the region $<20\mu m$ depth immediately under the free surface of the diffusion specimen.

The research worker Shri Badrinarayanan was awarded the Ph.D. degree in physics by the Madras University (1969) for his thesis 'Diffusion in solid state'.

CSIR SUPPORT TO RESEARCH

Completed Schemes

Solitary and Cnoidal Waves in Fluids

Solitary and cnoidal waves are permanent progressive waves of finite amplitude which can appear in homogeneous and heterogeneous fluids. The solitary wave can be looked upon as a limiting case of the periodic waves of permanent type (cnoidal waves), when the wavelength tends to infinity. Further, the same fundamental equation gives rise to both solitary and cnoidal waves depending on the boundary conditions imposed on it.

The mathematical and physical interest in the solitary waves is due to the fact that these waves depend for their existence on small effects, e.g. small non-hydrostatic pressures in the case of ordinary and interfacial solitary waves, small effects of density variation for solitary waves in media with continuous density stratification, and finally, small shear for solitary waves in westerly currents. Another point of interest about solitary and cnoidal waves is that these waves can be obtained starting from the non-linear shallow-water theory. An initially arbitrary long wave profile tends to organize itself into a solitary wave as it moves along. The solitary wave theory is capable of explaining the behaviour of breakers as they approach the shore. There has been a growing interest in this subject as these waves might play an important role in certain meteorological and other phenomenon where density changes are significant.

Some problems of interest in the field of solitary and cnoidal waves have been investigated by a CSIR research fellow, Shri S. Venkataraman, at the Department of Mathematics, Indian Institute of Technology, Kharagpur.

A study was made of the solitary waves at the interface of two fluids in a channel of arbitrary cross-section, when the initial velocity distributions of the two streams are arbitrary. It was found that when the two streams initially are at rest, the wave at the interface of the two fiuids is a wave of elevation or depression depending on whether the lower or upper layer is shallower of the two. This result is independent of the cross-section of the channel. The analysis was applied to rectangular channel in particular.

The propagation of solitary wave in a compressible medium in a channel of constant arbitrary cross-section of infinite length has been studied. Expressions for the wave profile and speed have been derived. It is observed that when the atmospheric pressure is considered as negligible, the solitary wave that exists at the free surface of a compressible fluid is a wave of elevation and it proceeds with supercritical speed.

In a study of irrotational solitary waves at the interface of a gas-liquid system in a closed channel of arbitrary cross-section, it has been found that the two values the critical speed of the flow assumes are mainly due to the compressibility of the upper medium. Also, the condition for the interfacial wave to be a wave of elevation (or depression) has been found to be the same as that for a two-liquid system.

The propagation of cnoidal waves in a compressible medium in a toroidal channel has been studied. Expressions for the critical speed, wave speed and profile have been derived. Two values for the critical speed of the flow were obtained.

From a study of the interfacial cnoidal waves in a two-liquid system in a toroidal channel of arbitrary cross-section expressions for the wave profile and speed of the cnoidal waves in a straight channel of arbitrary cross-section in a two-liquid system have been derived and the characteristics of a rectangular cross-section were studied as a special case.

The research scholar, Shri Venkataraman, was awarded the Ph.D. degree of the Indian Institute of Technology, Kharagpur for his thesis on the subject.

Morphology and Histology of Brain of a Cyprinoid Fish

Investigations on the morphology and histology of the brain of *Tor tor* in relation to the feeding habits are in progress under a CSIR research scheme in the Department of Zoology, D. A. V. College, Dehra Dun. The studies are being carried out by Mrs Kumud Sinha, a CSIR research fellow, under the direction of Dr M. B. Lal of the Department.

Tor tor, popularly known as red-finned mahaseer, is the famous edible fish which attains a considerable size and is found abundantly in the Doon Valley rivers. In the forebrain of the fish the paired olfactory bulbs lie much in advance of the rest of the brain and are borne by the long, thin and tubular olfactory tracts. The olfactory lobes are absent. The olfactory tracts are

continued posteriorly with the paired bean-shaped cerebral hemispheres. In diencephalon pineal bony remains situated on the dorsal side, hidden beneath the membranous roof of the brain. The pituitary body is a small flattened structure carried by a stalk and remains within the brain membrane at the floor of the cranium.

In the midbrain the paired optic lobes are well developed and the optic ventricle is invaded by valvula cerebelli, a unique teleostean feature.

In the hindbrain cerebellum is a well developed elongated solid structure. A round median facial lobe and paired oval vagal lobes, which lie on the sides of the medulla oblongata, are present.

The well developed facial and vagal lobes are found correlated with the taste, a feeding habit of the fish. The fish also possess four normal sized barbels.

The well developed cerebellum points to the fact that the fish is able to maintain its equilibrium in water efficiently as it comes to the surface from the midwater to collect its food. The well developed optic lobes show that vision also plays an important role in searching its food. On this basis *Tor tor* is grouped under the taste-and-sight feeder.

Patents Accepted

Indian Pat. 90469

Processing of mammalian intestines

S. K. Barat
CLRI, Madras

Mammalian small intestines of animal origin are used for a number of purposes. Being edible and tube like, they are extensively used as a casing for the sausage.

Before it can be used as casing for sausage, the intestine undergoes preliminary stripping, scraping and cleaning operations. The purpose of these operations is to get the usable part of the intestine, viz. the submucosa layer (second layer from inside) in a clean form. Conventionally, such cleansed casings are preserved and stored in salt all over the world to be used later. The mode of wet salting of casings however suffers from the following drawbacks:

(1) Because of lack of proper cleaning, the goods look dull and dirty coloured and the residual fatty material often goes rancid and mouldy and emits an unpleasant smell.

(2) Being wet, the goods have a limited storage life and are susceptible to bacterial and fungus attack and become weak.

(3) In wet salted condition, the goods present considerable difficulty in handling and packing and are expensive for air freight—the usual mode of transport from India.

The invention relates to the processing of 'dry ready-to-wet sausage casings' from mammalian intestines. The finished product is obtained in a most hygienic and dry form which soaks back to its full soft and flaccid condition in water. Being dry, it can be stored for any length of time without spoilage and, if desired, it can be fully sterilized. As it is very light in weight air freight is reduced considerably. The product has undergone factory trials of sausage filling in India and abroad.

The process has also been patented in UK, USA, Canada, USSR, Germany, Sweden, France, Japan, Australia, New Zealand, and other countries.

D. Schnebel (India) Private Ltd, Madras, to whom the patent has been issued, are regularly producing this new product.

PATENTS FILED

126620: Improvement in or relating to methods for the production of brucine sulphate and brucine, V.S. Prabhakar, C.K. Atal & C.L. Madan—RRL, Jammu.

126621: Light transmitting materials, J.P. Shah—CSIO, Chandigarh.

126622: A method for the manufacture of xanthotoxin from *Ammi majus* seeds, K. Ganapathi, C. K. Atal, B. R. Sharma, K. L.Bedi & M.S. Bhatia—RRL, Jammu.

126709: Improvements in or relating to the preparation of iron catalysts for hydrogenation of coal, D.K. Mukherjee, P.B. Chowdhury, A. N. Basu, N. G. Basak & A. Lahiri, CFRI, Dhanbad.

PATENTS SEALED

109904: Improvements in or relating to Foster-Seely type discriminator circiut, J. P. Raina & N. N. Seru—CEERI, Pilani.

RECRUITMENT TO THE SCIENTISTS' POOL

Applications are invited for the next bulk selection to the Scientists' Pool from persons with outstanding academic qualifications. Candidates should normally possess a doctorate degree in Science, Technology, Social Science or Humanities, or a Master's degree in Engineering or Medicine.

The Pool offers the following facilities: (i) assignment in an appropriate institution; (ii) a fixed salary between Rs 400 and Rs 700 per month plus allowances; higher salaries may be paid in exceptional cases; and (iii) freedom to apply for positions (under the government or in the public or private sectors) and to leave the Pool at short notice.

Pool placement is not a regular appointment, but is in the nature of a facility to enable well qualified persons to work while looking for regular positions. The temporary placement in the Pool is generally for a period of one year or two.

Persons already enrolled in the National Register of Scientific and Technical Personnel, who wish to be considered, are also required to furnish full and up-to-date particulars of qualifications, experience, etc.

Application forms can be obtained from the Secretary, Council of Scientific & Industrial Research (Division for Scientific and Technical Personnel), Rafi Marg, New Delhi 1. Completed forms should reach CSIR latest by 26 August 1970.

110409: A process for the preparation of hydrogen sulphide detector tube, A. K. Ghosh & N. N. Banerjee—CMRS, Dhanbad.

108414: A process for the treatment of costus (*Saussurea lappa*) roots or inulin isolated therefrom for the production of fructose, G. H. Kulkarni, G. R. Kelkar, J. L. Bose & S. C. Bhattacharyya—NCL, Poona,

109250: Axial piston pumps or motors, A. Dasgupta & B. K. Ray—CMERI, Durgapur.

109707: An area measuring machine particularly suited for measuring leather area, T. Ramanathan—CLRI, Madras.

109905: Improvements in or relating to wide-band double-tuned coupled IF amplifiers for TV receivers, J. P. Raina & N. N. Seru—CEERI, Pilani.

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